



Docket No.: 614.1804/HJS

**Box PATENT APPLICATION**

Assistant Commissioner for Patents  
Washington, D.C. 20231

**NEW APPLICATION TRANSMITTAL**

Dear Sir:

Transmitted herewith for filing is the ☒ utility  
☐ design patent application of inventor(s):  
Koji ARAI

Entitled:

COMMUNICATION METHOD AND APPARATUS FOR A RADIO LOCAL  
AREA NETWORK SYSTEM USING MACRODIVERSITY

Enclosed are:

1. The Papers Required For Filing Under 37 C.F.R. §1.53(b):

<u>25</u>	Page(s) of Specification
<u>7</u>	Page(s) of Claims
<u>1</u>	Page(s) of Abstract
<u>13</u>	Sheet(s) of <input checked="" type="checkbox"/> formal <input type="checkbox"/> informal drawings

2. ☒ Combined Declaration/Power of Attorney

3. ☒ An Assignment of the invention to:

FUJITSU LIMITED

4. Claim for Priority Under 35 U.S.C. §120

☐ The benefit under 35 U.S.C. §120 is hereby claimed from  
the following United States application(s):

5. Claim for Priority Under 35 U.S.C. §119

☒ The benefit of priority under 35 U.S.C. §119 is hereby  
claimed from the following foreign application(s):

Japanese Patent Application No. 8-189423  
Filed: July 18, 1996

☒ A certified copy of (each of) the above-identified  
foreign application(s) is enclosed.

6. Fee Calculation

				<u>CLAIMS AS FILED</u>		
<u>Number Filed</u>		<u>Number Extra</u>		<u>Rate</u>	<u>Basic Fee</u>	
					<u>\$ 770.00</u>	
Total Claims	12	-20=	0 X	\$ 22.00	0.00	
Independent Claims	5	- 3=	2 X	\$ 80.00	160.00	
Multiple dependent claim(s), if any				[ ] \$ 260.00	0.00	
				Filing Fee Calculation	\$ 930.00	

\*If the difference is less than zero, enter "0"

[ ] Amendment cancelling extra claims enclosed

[ ] Amendment deleting multiple dependencies enclosed

7. Small Entity Statement

[ ] A verified statement that this is a filing by a "small entity" under 37 C.F.R. §§ 1.9 and 1.27 is attached.

Filing Fee Calculation (50% of above) \$

8. Fee Payment

[ ] Not Enclosed

[ ] No filing fee is to be paid at this time.

[**xx**] Enclosed

[**xx**] Filing fee calculation above \$ 930.00

[**xx**] Recording assignment  
(\$40.00; 37 CFR §1.21(h)(1)) \$ 40.00

Total fees enclosed \$ 970.00

9. Method of Payment of Fees

[**xx**] Check in the amount of \$970.00

[ ] Charge Deposit Account No. 19-3935 in  
the amount of: \$  
A duplicate of this transmittal is attached.

10. Other Enclosures

11. Authorization to Credit Overpayment or Charge Additional Fees

[xx] The Commissioner is hereby authorized to credit any overpayment, or charge fees under 37 CFR 1.16 (filing fees) or 37 CFR 1.17 (application processing fees) which may be required, to Deposit Account 19-3935.

12. Correspondence Address:

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Respectfully submitted,

STAAS & HALSEY

By: 

H. J. Staas  
Registration No. 22,010

Date: February 6, 1997

2025 FEB 10 10 29 AM '97

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SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT I, Koji Arai, a citizen of Japan  
residing at Kawasaki-shi, Kanagawa, Japan have invented  
certain new and useful improvements in

COMMUNICATION METHOD AND APPARATUS FOR A RADIO LOCAL AREA  
NETWORK SYSTEM USING MACRODIVERSITY

of which the following is a specification : -

1 TITLE OF THE INVENTION

COMMUNICATION METHOD AND APPARATUS FOR A  
RADIO LOCAL AREA NETWORK SYSTEM USING MACRODIVERSITY

5 BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to a  
communication method and apparatus for a radio local  
area network (LAN) system, and more particularly, to a  
10 communication method and apparatus for a radio local  
area network (LAN) system, in which transmission  
performance may be improved by macrodiversity using a  
plurality of radio base stations.

15 2. Description of the Related Art

Recently, in a radio LAN system using a  
millimeter-wave band (for example, 30 GHz to 60 GHz),  
a very broad band transmission (for example, more than  
100-Mbps bit rate) is developing. In this case,  
20 taking millimeter-wave transmission performance into  
account, communication between a transmit unit and a  
receive unit needs to be a line-of-sight  
communication.

However, for example, in a radio LAN system  
25 used in an office, a radio transmission path between  
the transmit unit and the receive unit may be  
interrupted by person's motion or movement of people.  
In this case, a communication signal is also  
interrupted and may not be transmitted. To prevent  
30 the above-discussed interruption to the communication  
signal, macrodiversity is proposed.

FIG. 1 shows a configuration example of a  
prior-art radio LAN system using macrodiversity. In  
the prior-art radio LAN system using macrodiversity,  
35 inside the office, for a single terminal station  
connected to at least one terminal unit, a plurality  
of radio base stations (for example, base stations 1

1 to n) are provided. A signal transmitted from a  
wiring LAN system is transmitted to the plurality of  
radio base stations through a HUB (an apparatus for  
branching a network) in an asynchronous transfer mode  
5 (ATM). Then, from the plurality of radio base  
stations, the signals are simultaneously transmitted  
to the terminal station on different frequencies ( $f_1$   
to  $f_n$ ).

When the terminal station receives the  
10 signals transmitted from the plurality of radio base  
stations, the terminal station selects an optimum one  
(for example, a signal having a highest level) of the  
received signals, and demodulates a selected signal.  
In this way, by providing a plurality of transmission  
15 paths between a transmit side and a receive side,  
influence due to the above-discussed interruption to  
the transmission signal may be prevented. In this  
case, it is noted that to provide the radio LAN system  
shown in FIG. 1, for all of the transmission paths,  
20 substantially the same desired C/N (a ratio of energy  
of a modulated carrier signal to noise energy) ratio  
is required.

However, the following problem occurs in the  
above-discussed prior-art radio LAN system.

25 As previously discussed, in the radio LAN  
system, broad band transmission having a transmission  
rate of more than 100 Mbps is developing. In the  
prior-art radio LAN system shown in FIG. 1, to realize  
broad band transmission or more than 100-Mbps  
30 transmission rate, it is necessary for all of the  
transmission paths to achieve substantially the same  
desired C/N ratio at a transmission rate of more than  
100 Mbps. In order to satisfy the above-discussed  
conditions, for all of the radio base stations,  
35 excessive transmit power is required, and antenna gain  
of all the radio base stations and the terminal  
station needs to be further increased.

1 Further, in the prior-art radio LAN system,  
a number of carriers corresponding to a number of  
radio base stations is required. Therefore, a broad  
transmission frequency band is required for the number  
5 of radio base stations, and, thus, efficient use of  
frequencies may be degraded.

#### SUMMARY OF THE INVENTION

10 It is an object of the present invention to  
provide a communication method and apparatus for a  
radio LAN system using a macrodiversity function. In  
the method and apparatus, a broad band transmission  
may be provided with relatively low transmit power,  
relatively low antenna gain, and a relatively narrower  
15 transmission frequency band. This permits the  
disadvantages described above to be eliminated.

The object described above is achieved by a  
communication method for a radio LAN system having a  
communication at a first transmission rate, the method  
20 comprising the steps of: (a) time-divisionally  
distributing a first signal of the first transmission  
rate into  $n-1$  second signals ( $n = 3, 4, \dots$ ); (b)  
respectively converting the  $n-1$  second signals into  $n-1$   
third signals of a second transmission rate less  
25 than the first transmission rate; and (c) transmitting  
the  $n-1$  third signals of the second transmission rate  
through radio transmission paths between  $n-1$  radio  
base stations and a terminal station connected to at  
least one terminal unit.

30 The object described above is also achieved  
by the method mentioned above, wherein the second  
transmission rate is  $1/(n-1)$  of the first transmission  
rate.

The object described above is also achieved  
35 by a communication apparatus for a radio LAN system  
which provides communication at a first transmission  
rate, the apparatus comprising: a rate-conversion-and-

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1 distribution circuit for time-divisionally  
distributing a first signal of the first transmission  
rate into  $n-1$  second signals ( $n = 3, 4, \dots$ ) and  
respectively converting the  $n-1$  second signals into  $n-1$   
5 third signals of a second transmission rate less  
than the first transmission rate; and  $n-1$  radio base  
stations transmitting the  $n-1$  third signals of the  
second transmission rate to a terminal station  
connected to at least one terminal unit through radio  
10 transmission paths.

The object described above is also achieved  
by the apparatus mentioned above, wherein the second  
transmission rate is  $1/(n-1)$  of the first transmission  
rate.

15 The object described above is also achieved  
by a terminal station used in a radio LAN system  
having a rate-conversion-and-distribution circuit for  
time-divisionally distributing a first signal of a  
first transmission rate into  $n-1$  second signals ( $n =$   
20  $3, 4, \dots$ ) and respectively converting the  $n-1$  second  
signals into  $n-1$  third signals of a second  
transmission rate less than the first transmission  
rate, and  $n-1$  radio base stations transmitting the  $n-1$   
third signals of the second transmission rate to the  
25 terminal station connected to at least one terminal  
unit through radio transmission paths, the terminal  
station comprising: a receiver receiving the third  
signals of the second transmission rate transmitted  
from the  $n-1$  radio base stations; and a rate-  
30 conversion-and-multiplex circuit for converting and  
multiplexing received third signals of the second  
transmission rate into signals of the first  
transmission rate.

According to the above-discussed method for  
35 the radio LAN system, apparatus for the radio LAN  
system, and terminal station used in the radio LAN  
system, a fast transmission rate signal is converted



1 to a lower transmission rate signal, and the lower  
transmission rate signal is transmitted through radio  
transmission paths from a plurality of radio base  
stations to the terminal station. Therefore, under  
5 the same transmit power from the radio base stations,  
a ratio of a modulated signal to noise (C/N) of the  
lower transmission rate signal may be larger than that  
of the fast transmission rate signal.

Namely, in order to obtain a desired C/N,  
10 using the lower transmission rate signal, the transmit  
power of the radio base station may be reduced, and  
also, antenna gain of the radio base station and the  
terminal station may be reduced. As a result, power  
consumption of the radio LAN system may be reduced.  
15 Further, a relatively simplified antenna is applicable  
for the radio LAN system.

The object described above is also achieved  
by the method mentioned above, wherein: the radio LAN  
system further comprises at least one redundant radio  
20 base station n; and the method further comprises the  
steps of: (d) transmitting a fourth signal through a  
radio transmission path between the terminal station  
and the at least one redundant radio base station n,  
data of the fourth signal having a given relationship  
25 with data in signals transmitted between at least k  
( $k \leq (n-1)$ ) radio base stations of the n-1 radio base  
stations and the terminal station; and (e)  
compensating, when at least one transmission path  
between the at least k radio base stations and the  
30 terminal station is interrupted, data of the signal to  
be transmitted through an interrupted transmission  
path based on the data of the fourth signal  
transmitted between the at least one redundant radio  
base station n and the terminal station.

35 The object described above is also achieved  
by the method mentioned above, wherein the given  
relationship in the step (d) is that the data of the

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1 fourth signal transmitted between the at least one  
redundant radio base station n and the terminal  
station is a summation of data of the signals  
transmitted between the at least k radio base stations  
5 and the terminal station for each given time slot.

The object described above is also achieved  
by the method mentioned above, wherein: the radio LAN  
system further comprises at least one redundant radio  
base station n; and the method further comprises the  
10 steps of: (f) monitoring interruption of transmission  
paths between the n-1 radio base stations and the  
terminal station; and (g) compensating, when one of  
the transmission paths is interrupted, data of an  
interrupted transmission path by transmitting the data  
15 of the interrupted transmission path between the at  
least one redundant radio base station n and the  
terminal station.

The object described above is also achieved  
by the apparatus mentioned above, further comprising:  
20 at least one summation circuit for generating a fourth  
signal by summing data of at least k ( $k \leq (n-1)$ ) signals  
of the n-1 third signals of the second transmission  
rate for every timeslot; and at least one redundant  
radio base station n transmitting the fourth signal  
25 generated in the at least one summation circuit to the  
terminal station.

The object described above is also achieved  
by the apparatus mentioned above, further comprising:  
at least one redundant radio base station n  
30 transmitting a signal to the terminal station; a line  
monitoring circuit for monitoring interruption of  
transmission paths between the n-1 radio base stations  
and the terminal station; and a switching circuit,  
when at least one of the transmission paths is  
35 interrupted, for forwarding a signal to be transmitted  
through an interrupted transmission path to the at  
least one redundant radio base station n.

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1                   The object described above is also achieved  
by a terminal station used in a radio LAN system  
having a rate-conversion-and-distribution circuit for  
time-divisionally distributing a first signal of a  
5   first transmission rate into  $n-1$  second signals ( $n =$   
3, 4, ...) and respectively converting the  $n-1$  second  
signals into  $n-1$  third signals of a second  
transmission rate less than the first transmission  
rate,  $n-1$  radio base stations transmitting the  $n-1$   
10 third signals of the second transmission rate to the  
terminal station connected to at least one terminal  
unit through radio transmission paths, at least one  
first summation circuit for generating a fourth signal  
by summing data of at least  $k$  ( $k \leq (n-1)$ ) signals of the  
15  $n-1$  third signals of the second transmission rate for  
every timeslot, and at least one redundant radio base  
station  $n$  transmitting the fourth signal generated in  
the at least one first summation circuit to the  
terminal station, the terminal station comprising: a  
20 receiver receiving the third signals of the second  
transmission rate transmitted from the  $n-1$  radio base  
stations; a rate-conversion-and-multiplex circuit for  
converting and multiplexing received third signals of  
the second transmission rate into signals of the first  
25 transmission rate; a line monitoring circuit for  
monitoring interruption of transmission paths between  
the  $n-1$  radio base stations and the terminal station;  
at least one second summation circuit, when at least  
one of the transmission paths is interrupted, for  
30 generating a fifth signal by summing every timeslot  
data of at least  $k$  signals of signals transmitted from  
the  $n-1$  radio base stations except for a signal to be  
transmitted through an interrupted transmission path;  
at least one subtraction circuit for generating  
35 subtraction data between data of the signal  
transmitted from the redundant radio base station  $n$   
and data of the fifth signal generated in the second

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1 summation circuit; and a switching circuit for  
providing the subtraction data generated in the  
subtraction circuit to the rate-conversion-and-  
multiplex circuit instead of providing data of an  
5 interrupted signal detected in the monitoring circuit;  
wherein even if at least one of signals transmitted  
from the  $n-1$  radio base stations is interrupted, data  
of the interrupted signal is compensated.

The object described above is also achieved  
10 by a terminal station used in a radio LAN system  
having a rate-conversion-and-distribution circuit for  
time-divisionally distributing a first signal of a  
first transmission rate into  $n-1$  second signals ( $n =$   
3, 4, ...) and respectively converting the  $n-1$  second  
15 signals into  $n-1$  third signals of a second  
transmission rate less than the first transmission  
rate,  $n-1$  radio base stations transmitting the  $n-1$   
third signals of the second transmission rate to the  
terminal station connected to at least one terminal  
20 unit through radio transmission paths, at least one  
redundant radio base station  $n$  transmitting a signal  
to the terminal station, a first line monitoring  
circuit for monitoring interruption of transmission  
paths between the  $n-1$  radio base stations and the  
25 terminal station and a first switching circuit when at  
least one of the transmission paths is interrupted,  
for forwarding a signal to be transmitted through an  
interrupted transmission path to the at least one  
redundant radio base station  $n$ ; the terminal station  
30 comprising: a receiver receiving the third signals of  
the second transmission rate transmitted from the  $n-1$   
radio base stations; a rate-conversion-and-multiplex  
circuit for converting and multiplexing received third  
signals of the second transmission rate into signals  
35 of the first transmission rate; a second line  
monitoring circuit for monitoring interruption of  
transmission paths between the  $n-1$  radio base stations

1 and the terminal station; and a second switching  
circuit, when at least one of the transmission paths  
is interrupted, for providing the signal transmitted  
from the redundant radio base station to the rate-  
5 conversion-and-multiplex circuit instead of providing  
a signal to be transmitted through an interrupted  
transmission path; wherein even if at least one of  
signals transmitted from the n-1 radio base stations  
is interrupted, data of the interrupted signal is  
10 compensated.

According to the above-discussed method for  
the radio LAN system, the apparatus for the radio LAN  
system, and the terminal station used in the radio LAN  
system, in order to establish a fast data  
15 communication, the lower transmission rate data is  
transmitted through a plurality of radio transmission  
paths. Further, an additional redundant radio  
transmission path is provided, and the data in the  
interrupted transmission path is compensated.

20 Therefore, the transmit power and the  
antenna gain in the radio LAN system may be reduced,  
and also, a compensating function of the data of the  
interrupted transmission path may be obtained. As a  
result, a higher-rate-(broad band) data-transmission  
25 radio LAN system may be realized.

Further, since a required frequency band for  
transmission between the respective radio base  
stations and the terminal station may be reduced, even  
if taking a frequency band required for the redundant  
30 radio base station into account, usage frequency band  
for the radio LAN system may be significantly reduced.

Particularly, in the above-discussed  
specified system, the signal to be transmitted through  
the interrupted transmission path may be flexibly  
35 allocated to the redundant radio transmission path.  
Therefore, even when the transmission paths, a number  
thereof being the same as a number of the redundant

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1 radio transmission paths, are interrupted, signal data  
of the interrupted transmission paths may be  
efficiently compensated.

Other objects and further features of the  
5 present invention will be apparent from the following  
detailed description when read in conjunction with the  
accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

10 FIG. 1 shows a configuration example of a  
prior-art radio local area network (LAN) system using a  
macrodiversity;

FIG. 2 shows a block diagram of a first  
embodiment of a radio LAN system according to the  
15 present invention;

FIG. 3 shows illustrations for explaining an  
operation of a data-rate conversion part shown in FIG.  
2. A signal A indicates an input signal, signals B  
indicate temporally divided signals, and signals C  
20 indicate output signals for respective radio base  
stations after rate conversion;

FIG. 4 shows an illustration for explaining  
a relationship between signal data for radio base  
stations 1 to 3 and signal data for a redundant radio  
25 base station n, the signal data for the radio base  
stations 1 to n being provided in the signals C shown  
in FIG. 3;

FIG. 5 shows a configuration example of the  
data-rate conversion part and the radio base stations  
30 shown in FIG. 2;

FIG. 6 shows a configuration example of a  
terminal station shown in FIG. 2;

FIG. 7 shows a block diagram of a second  
embodiment of the radio LAN system according to the  
35 present invention;

FIG. 8 shows a configuration example of a  
data-rate conversion part and radio base stations

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1 shown in FIG. 7;

FIG. 9 shows a configuration example of a terminal station shown in FIG. 7;

5 FIG. 10 shows a block diagram of a third embodiment of the radio LAN system according to the present invention;

FIG. 11 shows a configuration example of a data-rate conversion part and radio base stations shown in FIG. 10;

10 FIG. 12 shows a block diagram of a fourth embodiment of the radio LAN system according to the present invention; and

FIG. 13 shows a configuration example of a data-rate conversion part and radio base stations shown in FIG. 12.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

First, a description will be given of a first embodiment of a radio LAN system according to the present invention, by referring to FIG. 2 to FIG. 6. FIG. 2 shows a block diagram of the first embodiment of the radio LAN system according to the present invention. FIG. 3 shows illustrations for explaining an operation of a data-rate conversion part shown in FIG. 2. A signal A indicates an input signal, signals B indicate temporally divided signals, and signals C indicate output signals for respective radio base stations after rate conversion.

FIG. 4 shows an illustration for explaining a relationship between signal data for radio base stations 1 to 3 and signal data for a redundant radio base station n, the signal data for the radio base stations 1 to n being provided in the signals C shown in FIG. 3. FIG. 5 shows a configuration example of the data-rate conversion part and the radio base stations shown in FIG. 2. FIG. 6 shows a configuration example of a terminal station shown in

1 FIG. 2.

In the radio LAN system according to the present invention shown in FIG. 2, inside an office, for a single terminal station 10 connected to at least one terminal unit, a plurality of radio base stations (in this case, a radio base station 1, a radio base station 2, a radio base station k (=3), and a radio base station n are provided.

In the first embodiment shown in FIG. 2, the radio base station n is used for the redundant radio base station (discussed in detail later). A signal transmitted from an external wiring LAN system is provided to a data-rate conversion part 20 through a HUB in an ATM. This input signal is represented by the signal A shown in FIG. 3. The input signal contains a signal for a terminal unit A, a signal for a terminal unit B, and a signal for a terminal unit C in addition to a discrimination signal.

Different case can exist in a connecting relation between the terminal station 10 and the terminal units A to C. For example, in one case, for each terminal station, the terminal unit is provided. In another case, a plurality of terminal units belong to a single terminal station. In either cases, by an address provided for each data, each data may be properly transmitted to an addressed terminal unit.

In the data-rate conversion part 20, as shown in the signals B in FIG. 3, the discrimination signal and the respective terminal-unit signals contained in the input signal A are time-divisionally divided into three signals for the radio base stations 1 to k (in the embodiment, k = 3) for each of the timeslots.

Further, as shown in the upper three signals of the signals C in FIG. 3, respective rates of the three divided signals are converted to three lower-rate signals. In this embodiment, the converted rate



1 is one-third of the input-signal data rate. Namely,  
in general, the input-signal data rate is converted to  
one divided by the number of radio base stations  $n-1$   
(in this case,  $k=n-1$ ).

5 Also, as shown in the bottom signal of the  
signals C in FIG. 3, for the redundant radio base  
station  $n$ , specified data which has a given  
relationship with the data of the divided three  
signals is generated. For example, as shown in FIG.  
10 4, the signal data for the redundant radio base  
station  $n$  may be set as a summation of the three  
signal data for the radio base stations 1 to  $k$ .

The above-discussed operation may be carried  
out by the configuration example of the data-rate  
15 conversion part 20 shown in FIG. 5. In a rate-  
conversion-and-distribution circuit 22 of the data-  
rate conversion part 20 shown in FIG. 5, the input  
signal shown in the signal A of FIG. 3 is converted to  
the upper three signal data of the signals C in FIG.  
20 3. Subsequently, in a summation circuit 24, the three  
signal data for the radio base stations 1 to  $k$  are  
summed with each other to produce the signal data for  
the redundant radio base station  $n$ . In FIG. 5, for  
example, when a 156-Mbps transmission signal is  
25 provided from the wiring LAN system through the ATM-  
HUB, three 52-Mbps ( $= 156 \text{ Mbps} / 3$ ) transmission  
signals are transmitted to the radio base stations 1  
to 3 and the redundant radio base station  $n$ .

Next, the four lower-rate-converted signals  
30 shown in the signals C of FIG. 3 are respectively  
transmitted to the terminal station 10. The terminal  
station 10 receives the above-discussed four signals  
through antennas and receivers corresponding to the  
four radio base stations.

35 As shown in FIG. 6, the terminal station 10  
has a rate-conversion-and-multiplex circuit 11 which  
converts the transmission rate (in this case, 52 Mbps)

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1 of the three signals transmitted from the radio base  
stations 1 to 3 and multiplexes them to reproduce an  
original fast rate signal (shown in the signal A of  
FIG. 3, 156 Mbps). The reproduced 156-Mbps signal  
5 contains the signal for the terminal unit A, the  
signal for the terminal unit B, and the signal for the  
terminal unit C. If only the terminal unit A is  
connected to the terminal station 10, only the signal  
for the terminal unit A is provided to the terminal  
10 unit A from the reproduced 156-Mbps signal.

As discussed above, in the radio LAN system  
according to the present invention, the fast-rate  
transmission signal transmitted from the wiring LAN  
system is converted to the lower-rate transmission  
15 signal, and is transmitted from the plurality of radio  
base stations to the terminal station 10. Therefore,  
under the same transmit power, a ratio of the  
modulated signal to noise (C/N ratio) in the lower-  
rate transmission signal becomes large as compared to  
20 that in the fast-rate transmission signal. Namely, in  
order to obtain the desired C/N ratio, in a case of  
the lower-rate transmission signal, the transmit power  
of the radio base station may be reduced, and the  
antenna gains of the radio base stations and the  
25 terminal station may also be reduced. Therefore,  
power consumption of the radio LAN system may be  
reduced, and a relatively simplified antenna is usable  
for the radio LAN system.

Next, a description will be given of an  
30 operation of the radio LAN system according to the  
present invention when one of the three transmission  
paths between the radio base stations 1 to 3 and the  
terminal station 10 is interrupted. In the following,  
for example, as shown in FIG. 2, a case where the  
35 transmission path between the radio base station 3 and  
the terminal station 10 is interrupted will be shown.

In the terminal station 10 shown in FIG. 6,

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1 the three signals transmitted from the radio base  
stations 1 to 3 are respectively monitored by  
interruption detection circuits 12-1, 12-2, 12-3, and  
which transmission path has been interrupted may be  
5 determined by an interruption detection control  
circuit 14. The interruption detection circuits 12-1,  
12-2, 12-3 may be easily constructed with, for  
example, an RF level detector, etc.

Further, in FIG. 6, in the same way as the  
10 summation circuit 24 in the data-rate conversion part  
20 shown in FIG. 5, the three signals from the radio  
base stations 1 to 3 are summed for each given  
timeslot in a summation circuit 13. In this case,  
when signal data transmitted from the interrupted  
15 transmission path is substantially random data due to  
noise, the interruption detection control circuit 14  
controls the signal data transmitted from the  
interrupted transmission path not to be added to the  
summation or to be all zero.

20 Therefore, in a subtraction circuit 15, when  
summed data from the summation circuit 13 is  
subtracted from the signal data transmitted from the  
redundant radio base station n, the subtraction  
circuit 15 may produce correct original signal data on  
25 the interrupted transmission path. Further, the  
interruption detection control circuit 14 controls a  
switching circuit 16 to insert the correct original  
signal data from the subtraction circuit 15 into the  
interrupted transmission path.

30 The above-discussed operation may be  
commonly represented by the following equation.

$$\text{data } k = \text{data } n - \{\text{data } 1 + \dots \text{data } (k-1) + \\ \text{data } (k+1) + \dots \text{data } (n-1)\},$$

35

where data i indicates data transmitted from a  
radio base station i to the terminal station 10.

1 By the above-discussed operation, the signal  
data lost due to interruption of the transmission path  
may be compensated. In the prior-art radio LAN system  
using macrodiversity, fast-rate data is transmitted to  
5 the terminal station through a plurality of radio  
transmission paths, the signal data lost due to  
interruption of the transmission path is intended to  
be compensated by signal data transmitted through  
another transmission path.

10 On the contrary, in the radio LAN system  
according to the present invention, in order to carry  
out a data communication at the same fast-rate  
transmission, the lower-rate data is transmitted to  
the terminal station through a plurality of  
15 transmission paths, and also, an additional redundant  
transmission path is provided. As a result, the lost  
data in the interrupted transmission path may be  
positively compensated.

20 Therefore, as discussed previously, the  
transmit power and the antenna gain may be reduced,  
and data compensation function in the interrupted  
transmission path may be positively obtained. As a  
result, the radio LAN system with higher-rate (broad  
band) data transmission may be realized.

25 In the above-discussed radio LAN system  
according to the present invention, the given  
relationship described in the data-rate conversion  
part 20 shown in FIG. 2 is not limited to a summation  
operation. Namely, when the transmission path is  
30 interrupted, lost data in the interrupted transmission  
path may be determined from the other signal data by  
any operation, the operation is applicable for the  
data-rate conversion part 20.

35 Next, a description will be given of a  
second embodiment of the radio LAN system according to  
the present invention, by referring to FIG. 7 to FIG.  
9. FIG. 7 shows a block diagram of the second

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1 embodiment of the radio LAN system according to the  
present invention. FIG. 8 shows a configuration  
example of a data-rate conversion part and radio base  
stations shown in FIG. 7. FIG. 9 shows a  
5 configuration example of a terminal station shown in  
FIG. 7.

The second embodiment of the radio LAN system shown in FIG. 7 has substantially the same operation as that of the first embodiment of the radio LAN system shown in FIG. 2. In the radio LAN system shown in FIG. 7, in addition to a plurality of conventional radio base stations 1 to n-1 (in an example of FIG. 7, to simplify the description, only the radio base stations 1, 2 are shown), a plurality of redundant radio base stations (radio base stations n, n+1, in FIG. 7) are provided.

Namely, in the second embodiment shown in FIG. 7, in the same way as the data-rate conversion part 20 shown in FIG. 2, in a data-rate conversion part 40, the signal (for example, 156 Mbps) transmitted from the wiring LAN system through the ATM-HUB is distributed into (n-1) signals corresponding to the radio base stations 1 to n-1. Further, the distributed signals are converted to lower-rate signals (for example,  $156/(n-1)$  Mbps). The above-discussed operation is carried out in a rate-conversion-and-distribution circuit 42 shown in FIG. 8.

Further, in the data-rate conversion part 40 shown in FIG. 8, the signals for the (n-1) conventional radio base stations are distributed into two groups of signals (for example, odd-number radio base stations and even-number radio base stations). In summation circuits 44-1, 44-2, the two groups of signals are respectively summed for each given timeslot to generate two signals for the redundant radio base station n and the redundant radio base

1 station  $n+1$ .

The rate-converted signals produced from the data-rate conversion part 40 are respectively transmitted to the terminal station 30 on the lower frequency band through the radio base stations 1 to  $n+1$ .

In the terminal station 30 shown in FIG. 9, signals received from the radio base stations 1 to  $n-1$  are provided to a rate-conversion-and-multiplex circuit 31. The rate-conversion-and-multiplex circuit 31 converts the received signals into original-fast-rate (156Mbps) signals, and multiplexes the received signals to reproduce an original signal transmitted from the wiring LAN system.

In the same way as the terminal station 10 shown in FIG. 6, the terminal station 30 has interruption detection circuits 32-1 to 32- $(n-1)$  on transmission paths for the radio base stations 1 to  $n-1$  and an interruption detection control circuit 34 connected to the interruption detection circuits 32-1 to 32- $(n-1)$ . The interruption detection control circuit 34 may detect which transmission path has been interrupted.

Further, in FIG. 9, in the same way as the data-rate conversion part 40, signals transmitted from the radio base stations 1 to  $n-1$  are distributed into two groups of signals (in this case, signals from the odd-number radio base stations, and signals from the even-number radio base stations). In summation circuits 33-1, 33-2, the two groups of signals are respectively summed for each given timeslot.

At this time, when a certain transmission path is interrupted, since the signal data transmitted from the interrupted transmission path is substantially random data due to noise, the interruption detection control circuit 34 controls the signal data transmitted from the interrupted

1 transmission path not to be added to the summation or  
to be all zero.

Further, in subtraction circuits 35-1, 35-2,  
when summed data from the summation circuits 33-1, 33-  
5 2 is respectively subtracted from the signal data  
transmitted from the redundant radio base stations  $n$   
and  $n+1$ , one of the subtraction circuits 35-1, 35-2  
may produce correct original signal data of the  
interrupted transmission path. Further, the  
10 interruption detection control circuit 34 controls a  
switching circuit 34 to insert the correct original  
signal data from one of the subtraction circuits 35-1,  
35-2 into the interrupted transmission path.

Namely when the transmission path for the  
15 odd-number radio base station is interrupted, the  
correct signal data is inserted by the subtraction  
circuit 35-1, and when the transmission path for the  
even-number radio base station is interrupted, the  
correct signal data is inserted by the subtraction  
20 circuit 35-2.

According to the above-discussed radio LAN  
system, in the same way as the radio LAN system shown  
in FIG. 2, an advantage by the lower-rate radio  
transmission is provided. Further, even when two  
25 transmission paths (in the different groups) are  
simultaneously interrupted, the signal data of the  
interrupted transmission paths may be positively  
compensated.

In the radio LAN system shown in FIG. 7, the  
30 transmission paths between the radio base stations and  
the terminal station 30 are distributed into the two  
groups of signals, and the two redundant radio base  
stations are provided. However, by providing an  
additional number of groups of transmission paths and  
35 an additional number of redundant radio base stations,  
compensating performance for the interrupted data may  
be improved.

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1                   Next, a description will be given of a third  
embodiment of the radio LAN system according to the  
present invention, by referring to FIG. 10 and FIG.  
11. FIG. 10 shows a block diagram of the third  
5   embodiment of the radio LAN system according to the  
present invention. FIG. 11 shows a configuration  
example of a data-rate conversion part and radio base  
stations shown in FIG. 10. A terminal station 50  
shown in FIG. 10 has substantially the same  
10   configuration as that of the data-rate conversion part  
and the radio base stations shown in FIG. 11.

                  In the radio LAN system according to the  
present invention shown in FIG. 10, inside the office,  
for the single terminal station 50 connected to at  
15   least one terminal unit, a plurality of radio base  
stations (in this case, radio base stations 1 to n)  
are provided. In the third embodiment shown in FIG.  
10, the radio base station n is used for the redundant  
radio base station. Further, between the respective  
20   radio base stations and the terminal station 50, two-  
way communications are established. Therefore, as  
shown in FIG. 11, in each radio base station  
(including a data-rate conversion part 60) and the  
terminal station 50, a transmitter, the rate-  
25   conversion-and-distribution circuit, and the rate-  
conversion-and-multiplex circuit are respectively  
provided.

                  Further, because of the two-way  
communication, by monitoring an up-link transmission  
30   path from the terminal station 50 to the radio base  
station, the radio base station also may monitor  
whether the transmission path is interrupted (referred  
to as an interruption state). Therefore, as shown in  
FIG. 10 and FIG. 11, in the data-rate conversion part  
35   60, an up-link monitoring mechanism comprising  
interruption detection circuits 66-1 to 66-(n-1) and  
an interruption detection control circuit 67 is

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1 provided.

In the following, a description will be given of an operation of the radio LAN system shown in FIG. 10.

5 The signal transmitted from the external wiring LAN system is provided to the data-rate conversion part 60 through the ATM-HUB. In the same way as the first embodiment of the radio LAN system shown in FIG. 2, the input signal is distributed into  
10 a plurality of signals, each having a  $1/(n-1)$  of the input-signal's transmission rate. Distributed signals are transmitted of the terminal station 50 through the radio base stations 1 to  $n-1$ .

In this case, to the signal for the  
15 redundant radio base station  $n$ , one of the signals for the radio base stations 1 to  $n-1$  may be allocated by a switching circuit 64.

In the terminal station 50, in the same operation as that of the radio LAN system shown in  
20 FIG. 2, received signals from the radio base stations 1 to  $n-1$  are provided to a rate-conversion-and-multiplex circuit 61 to be converted and multiplexed into an original fast-rate (156 Mbps) signal. As a result, an original signal which has been transmitted  
25 from the wiring LAN system is reproduced.

In the same way, because of the two-way communication, the lower-rate signals which are converted and distributed in the terminal station 50 are transmitted to the respective radio base stations  
30 1 to  $n-1$ , and are converted and multiplexed to the original fast-rate signal in the rate-conversion-and-multiplex circuit 61 of the data-rate conversion part 60 to reproduce the signal to be transmitted to the wiring LAN system.

35 As shown in FIG. 10, when the transmission paths between the radio base station  $k$  and the terminal station 50 is interrupted, the interrupted

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1 transmission path is detected by the up-link  
monitoring mechanism in the data-rate conversion part  
60. Subsequently, by the switching circuit 64, the  
signal data in the interrupted transmission path (data  
5 from the radio base station k) is transmitted to the  
redundant radio base station n, and is transmitted to  
the terminal station 50.

In the terminal station 50, a down-link  
monitoring mechanism having the same configuration as  
10 that of the up-link monitoring mechanism is provided.  
Therefore, the terminal station 50 also detects the  
interrupted transmission path. Accordingly, by a  
switching circuit (corresponding to the switching  
circuit 63 in the data-rate conversion part 60), the  
15 data transmitted from the radio base station n is used  
instead of the data from the radio base station k.

In the above-discussed operation, by using  
the down-link monitoring mechanism in the terminal  
station 50, the terminal station 50 may detect the  
20 interrupted transmission path. However, also by  
providing information of an output result (the  
interrupted transmission path) of the up-link  
monitoring mechanism into the data transmitted from  
the radio base station n to the terminal station 50,  
25 the terminal station 50 may detect the interrupted  
transmission path from that information in order to  
control the switching circuit.

Next, a description will be given of a  
fourth embodiment of the radio LAN system according to  
30 the present invention, by referring to FIG. 12 and  
FIG. 13. FIG. 12 shows a block diagram of the fourth  
embodiment of the radio LAN system according to the  
present invention. FIG. 13 shows a configuration  
example of a data-rate conversion part and radio base  
35 stations shown in FIG. 12. A terminal station 70  
shown in FIG. 12 has substantially the same  
configuration as that of the data-rate conversion part

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1 and the radio base stations shown in FIG. 13.

The fourth embodiment of the radio LAN system shown in FIG. 12 has substantially the same operation as that of the third embodiment of the radio LAN system shown in FIG. 10. In the radio LAN system shown in FIG. 12, in addition to a plurality of conventional radio base stations 1 to n-1 (in an example of FIG. 12, to simplify the description, only the radio base stations 1, 2 are shown), a plurality of redundant radio base stations (radio base stations n, n+1) are provided.

In the fourth embodiment shown in FIG. 12, the operations, in which the signal transmitted from the wiring LAN system through the ATM-HUB is transmitted to a terminal station 70 through a data-rate conversion part 80 and the radio base stations 1 to n-1, and an operation that the signal produced from the terminal station 70 is transmitted to the wiring LAN system through the radio base stations 1 to n-1 and the data-rate conversion part 80, are substantially the same as the operations of the third embodiment of the radio LAN system shown in FIG. 10. Therefore, also in the fourth embodiment of the radio LAN system, between the radio base stations 1 to n-1 and the terminal station 70, the signals may be transmitted at the lower transmission rate.

Further, in the fourth embodiment shown in FIG. 12, different from the third embodiment shown in FIG. 10, the redundant radio base station n+1 is additionally provided. As shown in FIG. 13, the redundant radio base station n+1 with the redundant radio base station n is connected to a switching circuit 84. In the switching circuit 84, by an up-link monitoring mechanism constructed with interruption detection circuits 86-1 to 86-(n-1) and an interruption detection control circuit 87, data to be transmitted to the radio base station on an

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1 interrupted transmission path is controlled to be  
transmitted to the redundant radio base station n or  
the redundant radio base station n+1.

5 In the same way as a down-link transmission  
path, the redundant radio base station n+1 with the  
redundant radio base station n is connected to a  
switching circuit 83. In the switching circuit 83, by  
the down-link monitoring mechanism, instead of data  
10 transmitted from the radio base station through the  
interrupted transmission path, data transmitted from  
the redundant radio base station n or the redundant  
radio base station n+1 is selected and is provided to  
a rate-conversion-and-multiplex circuit 81.

15 In the above-discussed operation, when one  
of the transmission paths between the radio base  
stations 1 to n-1 and the terminal station 70 is  
interrupted, the redundant radio base station n is  
used. Further, when two of the transmission paths are  
simultaneously interrupted, the redundant radio base  
20 station n and the redundant radio base station n+1 are  
used.

As discussed above, in the fourth embodiment  
of the radio LAN system, in the same way as the radio  
LAN system shown in FIG. 10, advantages based on the  
25 lower-rate radio transmission may be obtained.  
Further, even when a plurality of transmission paths  
are simultaneously interrupted, the signal data of the  
interrupted transmission paths may be positively  
compensated.

30 In the fourth embodiment of the radio LAN  
system shown in FIG. 12, the two redundant radio base  
stations are provided. However, by providing an  
additional number of redundant radio base stations,  
data of an additional number of interrupted  
35 transmission paths may be compensated while obtaining  
the advantages based on the lower-rate radio  
transmission.

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1                   Further, the present invention is not  
limited to these embodiments, but other variations and  
modifications may be made without departing from the  
scope of the present invention.

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1     WHAT IS CLAIMED IS:

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1. A communication method for a radio LAN system providing communication at a first transmission rate, said method comprising the steps of:

10         (a) time-divisionally distributing a first signal of said first transmission rate into n-1 second signals ( $n = 3, 4, \dots$ );

15         (b) respectively converting said n-1 second signals into n-1 third signals of a second transmission rate less than said first transmission rate; and

20         (c) transmitting said n-1 third signals of said second transmission rate through radio transmission paths between n-1 radio base stations and a terminal station connected to at least one terminal unit.

25         2. The method as claimed in claim 1, wherein said second transmission rate is  $1/(n-1)$  of said first transmission rate.

30

3. The method as claimed in claim 1, wherein:

35         said radio LAN system further comprises at least one redundant radio base station n; and said method further comprises the steps of:  
       (d) transmitting a fourth signal through a

1 radio transmission path between said terminal station  
and said at least one redundant radio base station n,  
data of said fourth signal having a given relationship  
with data in signals transmitted between at least k  
5 (k≤(n-1)) radio base stations of said n-1 radio base  
stations and said terminal station; and

(e) compensating, when at least one  
transmission path between said at least k radio base  
stations and said terminal station is interrupted,  
10 data of the signal to be transmitted through an  
interrupted transmission path based on said data of  
said fourth signal transmitted between said at least  
one redundant radio base station n and said terminal  
station.

15

4. The method as claimed in claim 3, wherein  
20 said given relationship in said step (d) is that said  
data of said fourth signal transmitted between said at  
least one redundant radio base station n and said  
terminal station is a summation of data of the signals  
transmitted between said at least k radio base  
25 stations and said terminal station for each given time  
slot.

30

5. The method as claimed in claim 1,  
wherein:

said radio LAN system further comprises at  
least one redundant radio base station n; and

35 said method further comprises the steps of:

(f) monitoring interruption of transmission  
paths between said n-1 radio base stations and said

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1 terminal station; and

(g) compensating, when one of said  
transmission paths is interrupted, data of an  
interrupted transmission path by transmitting said  
5 data of the interrupted transmission path between said  
at least one redundant radio base station n and said  
terminal station.

10

6. A communication apparatus for a radio LAN  
system providing communication at a first transmission  
rate, said apparatus comprising:

15 rate-conversion-and-distribution means for  
time-divisionally distributing a first signal of said  
first transmission rate into n-1 second signals (n =  
3, 4, ...) and respectively converting said n-1 second  
signals into n-1 third signals of a second  
20 transmission rate less than said first transmission  
rate; and

n-1 radio base stations transmitting said n-  
1 third signals of said second transmission rate to a  
terminal station connected to at least one terminal  
25 unit through radio transmission paths.

30 7. The apparatus as claimed in claim 6,  
wherein said second transmission rate is  $1/(n-1)$  of  
said first transmission rate.

35

8. The apparatus as claimed in claim 6,

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1 further comprising:

at least one summation means for generating  
a fourth signal by summing data of at least  $k$  ( $k \leq (n-1)$ ) signals of said  $n-1$  third signals of said second  
5 transmission rate every timeslots; and

at least one redundant radio base station  $n$   
transmitting said fourth signal generated in said at  
least one summation means to said terminal station.

10

9. The apparatus as claimed in claim 6,  
further comprising:

15 at least one redundant radio base station  $n$   
transmitting a signal to said terminal station;

line monitoring means for monitoring  
interruption of transmission paths between said  $n-1$   
radio base stations and said terminal station; and

20 switching means, when at least one of said  
transmission paths is interrupted, for forwarding a  
signal to be transmitted through an interrupted  
transmission path to said at least one redundant radio  
base station  $n$ .

25

10. A terminal station used in a radio LAN  
30 system having rate-conversion-and-distribution means  
for time-divisionally distributing a first signal of a  
first transmission rate into  $n-1$  second signals ( $n =$   
3, 4, ...) and respectively converting said  $n-1$  second  
signals into  $n-1$  third signals of a second  
35 transmission rate less than said first transmission  
rate, and  $n-1$  radio base stations transmitting said  $n-1$   
third signals of said second transmission rate to

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1 said terminal station connected to at least one  
terminal unit through radio transmission paths, said  
terminal station comprising:

5 a receiver receiving said third signals of  
said second transmission rate transmitted from said n-  
1 radio base stations; and

rate-conversion-and-multiplex means for  
converting and multiplexing received third signals of  
said second transmission rate into signals of said  
10 first transmission rate.

15 11. A terminal station used in a radio LAN  
system having rate-conversion-and-distribution means  
for time-divisionally distributing a first signal of a  
first transmission rate into n-1 second signals (n =  
3, 4, ...) and respectively converting said n-1 second  
20 signals into n-1 third signals of a second  
transmission rate less than said first transmission  
rate, n-1 radio base stations transmitting said n-1  
third signals of said second transmission rate to said  
terminal station connected to at least one terminal  
25 unit through radio transmission paths, at least one  
first summation means for generating a fourth signal  
by summing data of at least k ( $k \leq (n-1)$ ) signals of  
said n-1 third signals of said second transmission  
rate for every timeslot, and at least one redundant  
30 radio base station n transmitting said fourth signal  
generated in said at least one first summation means  
to said terminal station, said terminal station  
comprising:

35 a receiver receiving said third signals of  
said second transmission rate transmitted from said n-  
1 radio base stations;

rate-conversion-and-multiplex means for

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1 converting and multiplexing received third signals of  
said second transmission rate into signals of said  
first transmission rate;

line monitoring means for monitoring  
5 interruption of transmission paths between said n-1  
radio base stations and said terminal station;

at least one second summation means, when at  
least one of said transmission paths is interrupted,  
for generating a fifth signal by summing data of every  
10 timeslots of at least k signals of signals transmitted  
from said n-1 radio base stations except for a signal  
to be transmitted through an interrupted transmission  
path;

at least one subtraction means for  
15 generating subtraction data between data of the signal  
transmitted from said redundant radio base station n  
and data of said fifth signal generated in said second  
summation means; and

switching means for providing said  
20 subtraction data generated in said subtraction means  
to said rate-conversion-and-multiplex means instead of  
providing data of an interrupted signal detected in  
said monitoring means;

wherein even when at least one of signals  
25 transmitted from said n-1 radio base stations is  
interrupted, data of the interrupted signal is  
compensated.

30

12. A terminal station used in a radio LAN  
system having rate-conversion-and-distribution means  
for time-divisionally distributing a first signal of a  
35 first transmission rate into n-1 second signals (n =  
3, 4, ...) and respectively converting said n-1 second  
signals into n-1 third signals of a second

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1 transmission rate less than said first transmission  
rate, n-1 radio base stations transmitting said n-1  
third signals of the second transmission rate to said  
terminal station connected to at least one terminal  
5 unit through radio transmission paths, at least one  
redundant radio base station n transmitting a signal  
to said terminal station, first line monitoring means  
for monitoring interruption of transmission paths  
between said n-1 radio base stations and said terminal  
10 station, and first switching means, when at least one  
of said transmission paths is interrupted, for  
forwarding a signal to be transmitted through an  
interrupted transmission path to said at least one  
redundant radio base station n; said terminal station  
15 comprising:  
a receiver receiving said third signals of  
the second transmission rate transmitted from said n-1  
radio base stations;  
rate-conversion-and-multiplex means for  
20 converting and multiplexing received third signals of  
the second transmission rate into signals of said  
first transmission rate;  
second line monitoring means for monitoring  
interruption of transmission paths between said n-1  
25 radio base stations and said terminal station; and  
second switching means, when at least one of  
said transmission paths is interrupted, for providing  
the signal transmitted from said redundant radio base  
station to said rate-conversion-and-multiplex means  
30 instead of providing a signal to be transmitted  
through an interrupted transmission path;  
wherein even when at least one of signals  
transmitted from said n-1 radio base stations is  
interrupted, data of the interrupted signal is  
35 compensated.

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1     ABSTRACT OF THE DISCLOSURE

          A communication method for a radio LAN  
system provides communication at a first transmission  
rate. In the method, a first signal of the first  
5     transmission rate is time-divisionally distributed  
into  $n-1$  second signals ( $n = 3, 4, \dots$ ). The  $n-1$   
second signals are respectively converted into  $n-1$   
third signals of a second transmission rate less than  
the first transmission rate. And, the  $n-1$  third  
10    signals of the second transmission rate are  
transmitted through radio transmission paths between  
 $n-1$  radio base stations and a terminal station  
connected to at least one terminal unit.

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FIG. 1 PRIOR ART

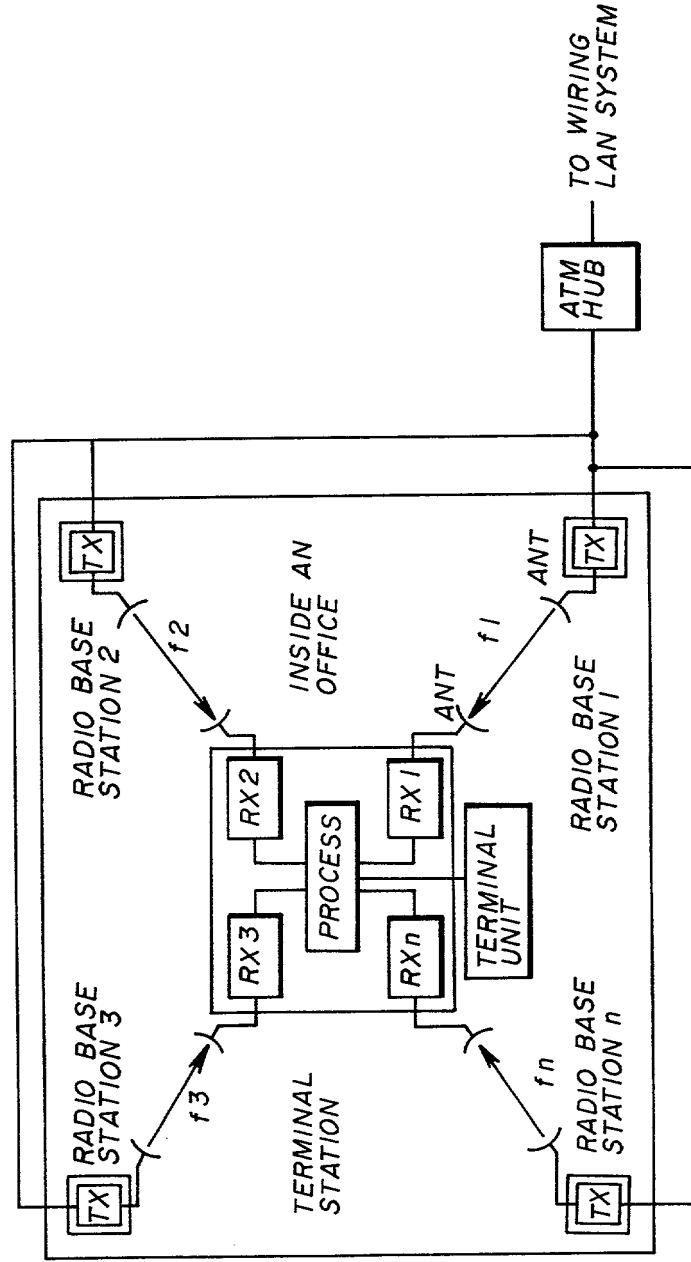


FIG. 2

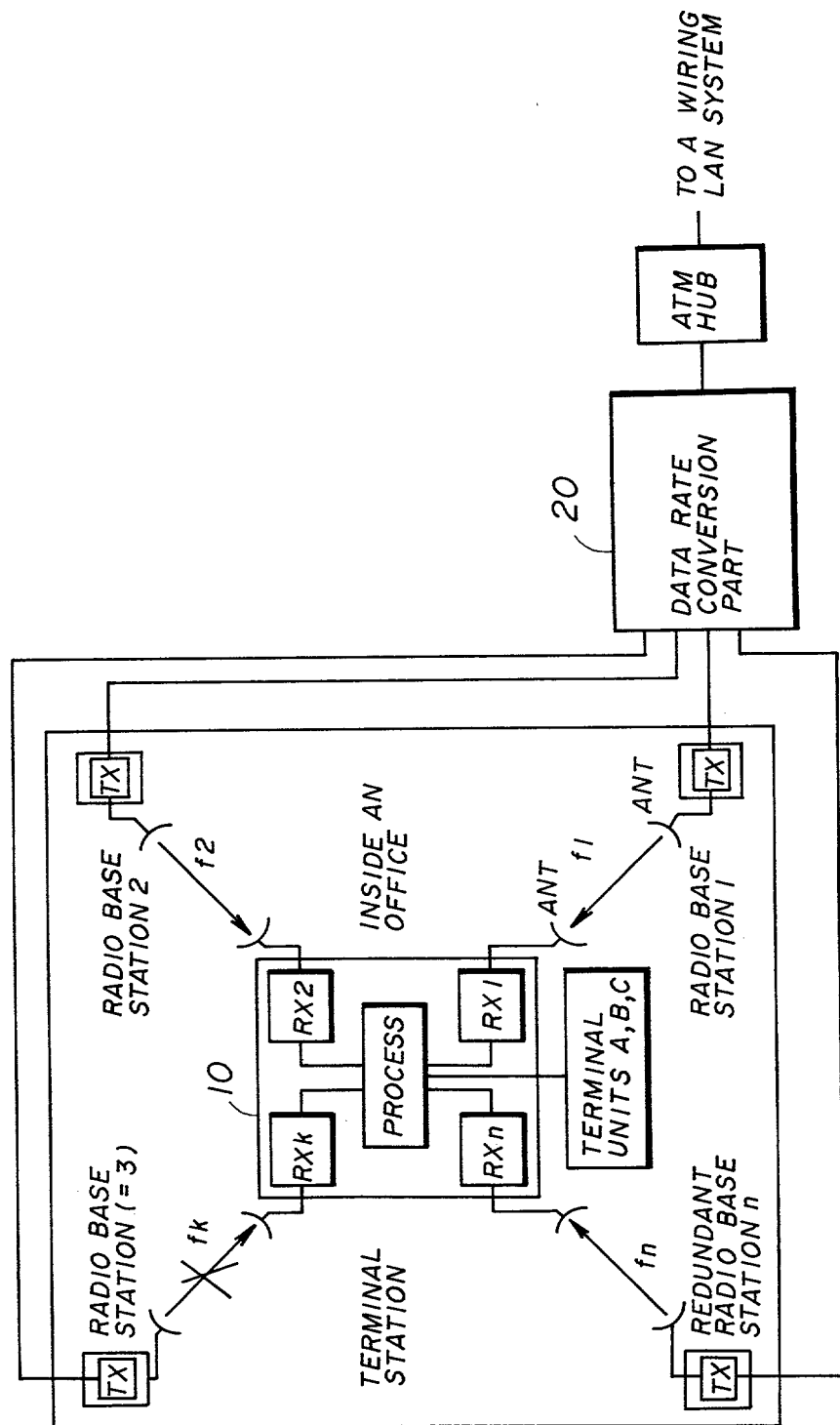
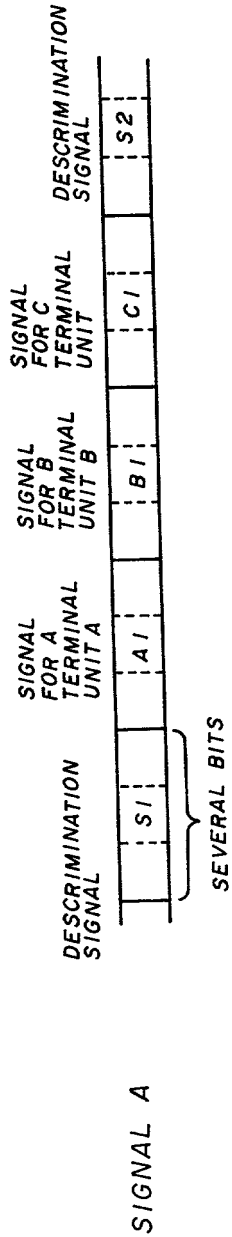


FIG.3



SIGNALS B

SIGNAL FOR A  
RADIO BASE STATION 1

SIGNAL FOR A  
RADIO BASE STATION 2

SIGNAL FOR A  
RADIO BASE STATION 3

SIGNALS C

OUTPUT SIGNAL OF THE  
RADIO BASE STATION 1

OUTPUT SIGNAL OF THE  
RADIO BASE STATION 2

OUTPUT SIGNAL OF THE  
RADIO BASE STATION 3

OUTPUT SIGNAL OF THE  
RADIO BASE STATION n



FIG.4

RADIO BASE STATION 1	1100101011001001
RADIO BASE STATION 2	0110001101010011
RADIO BASE STATION 3	+1101100110010110
REDUNDANT RADIO BASE STATION n	0111000000001100

FIG. 5

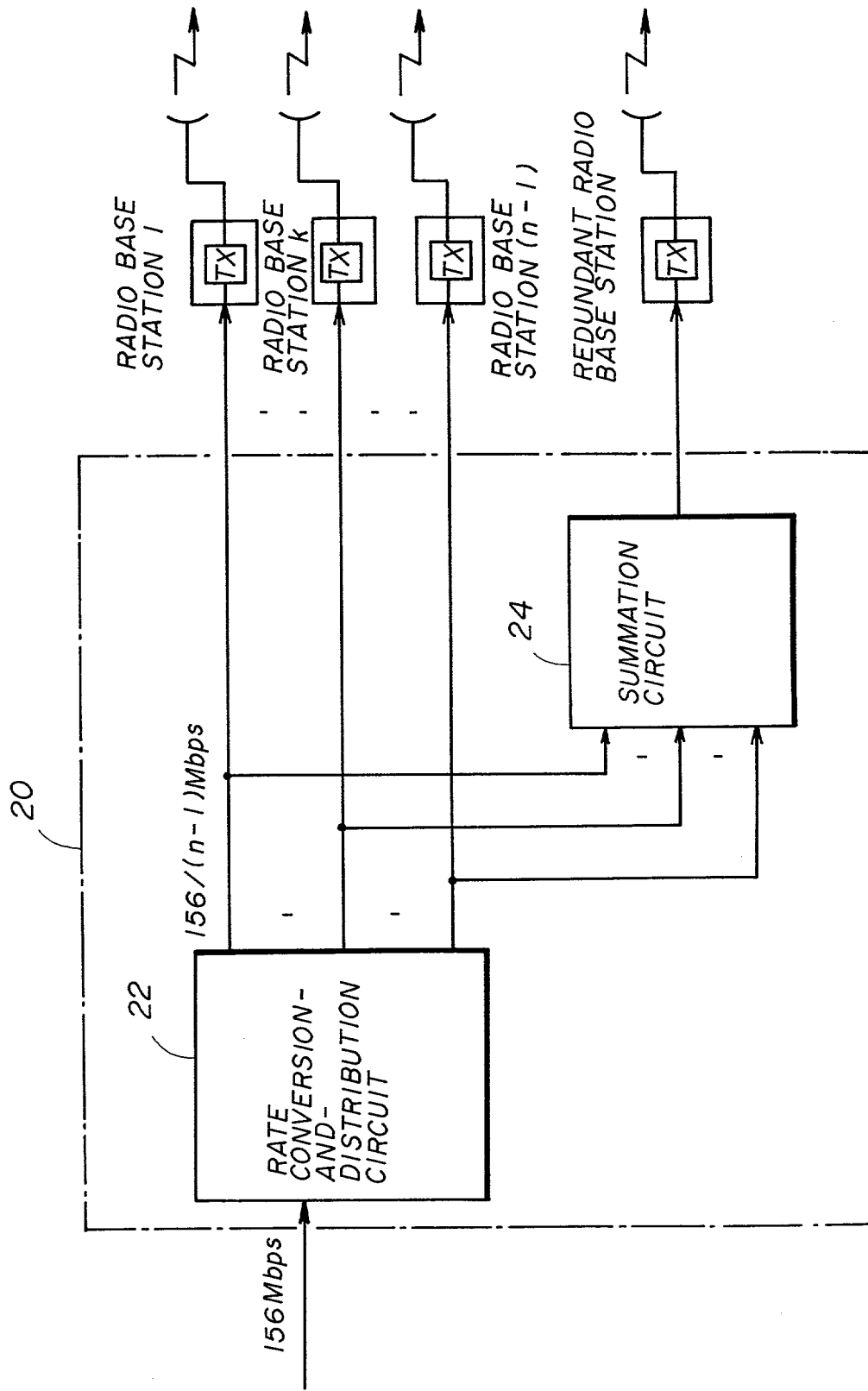


FIG. 6

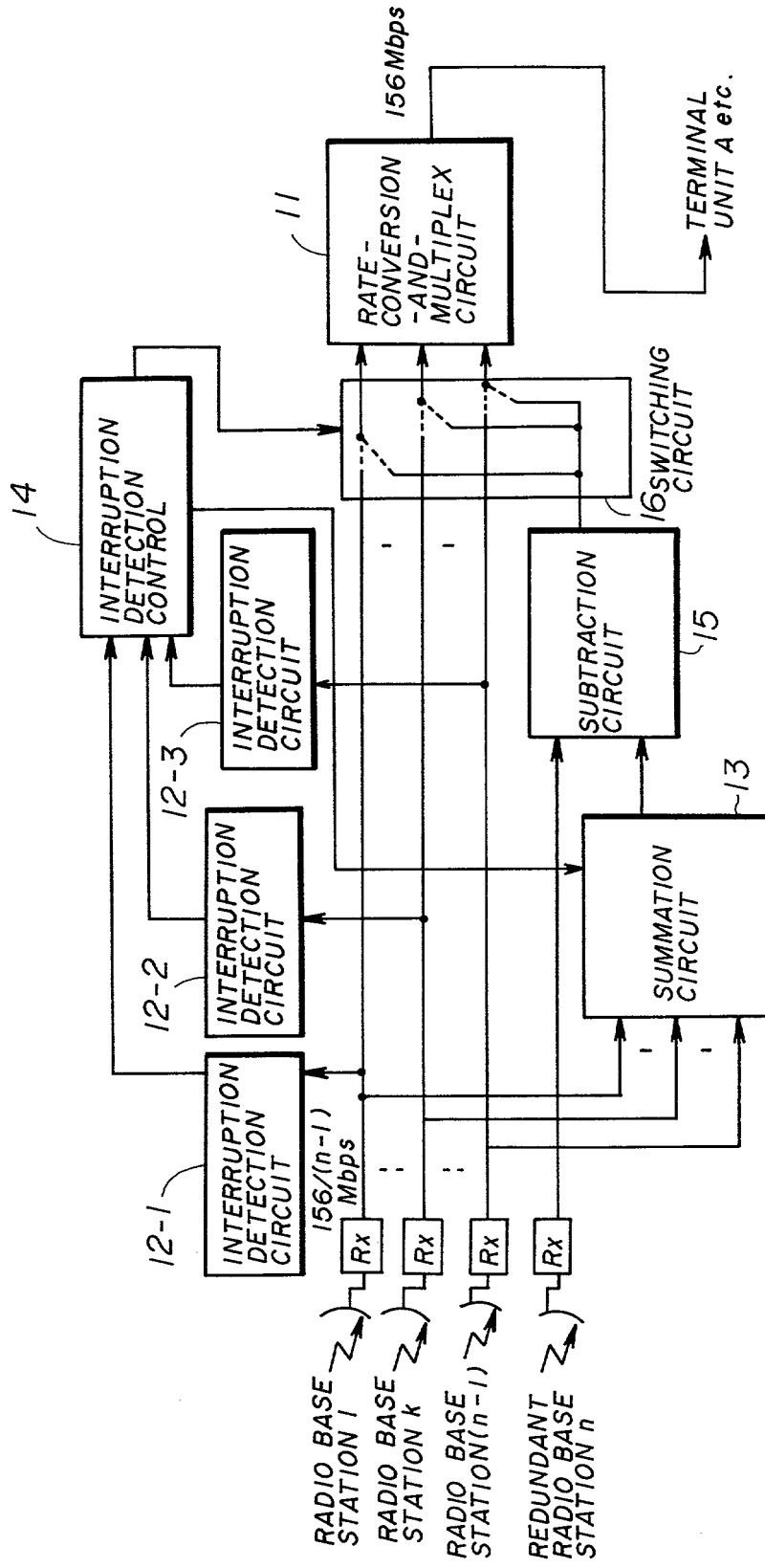


FIG. 7

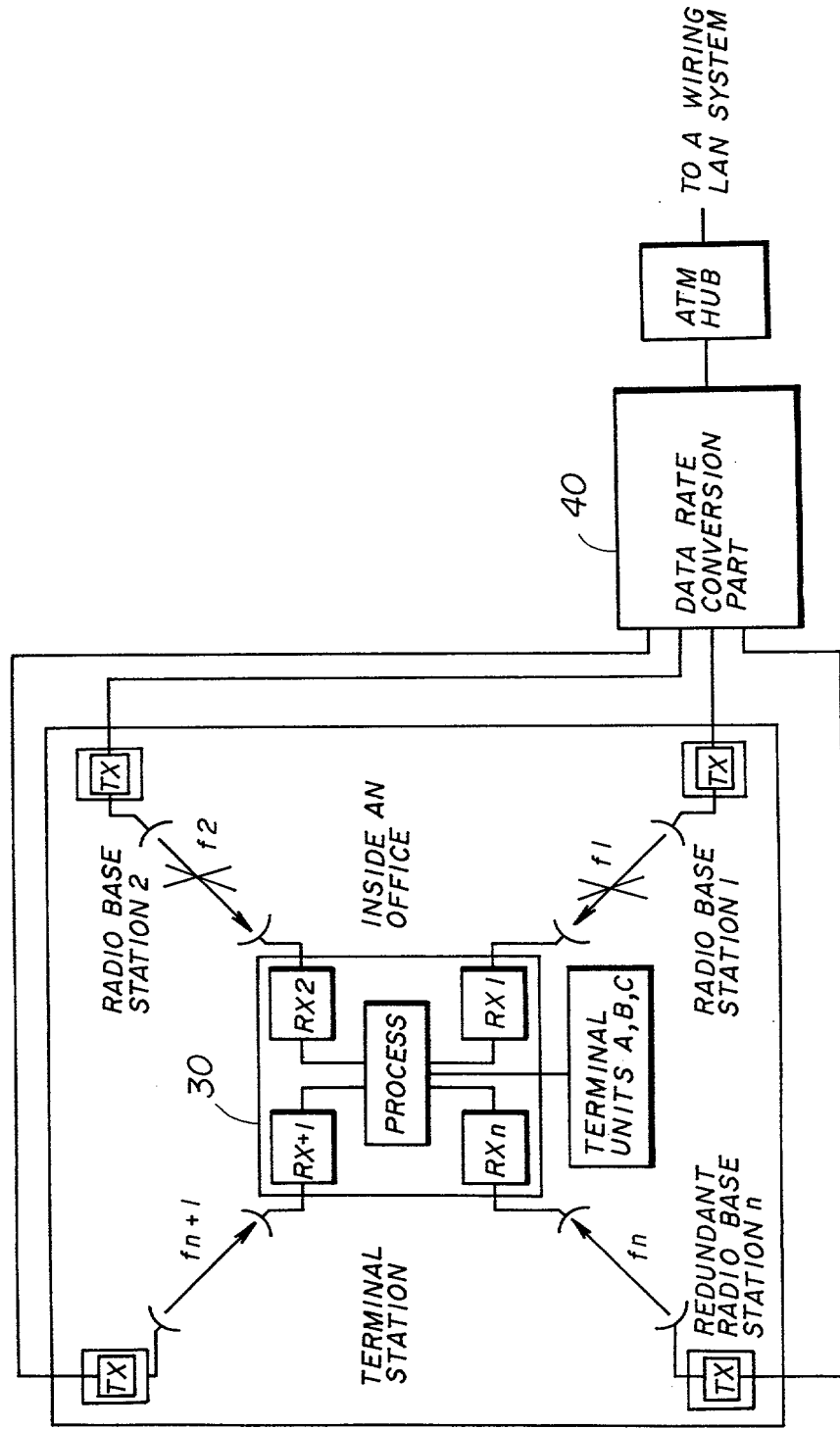


FIG. 8

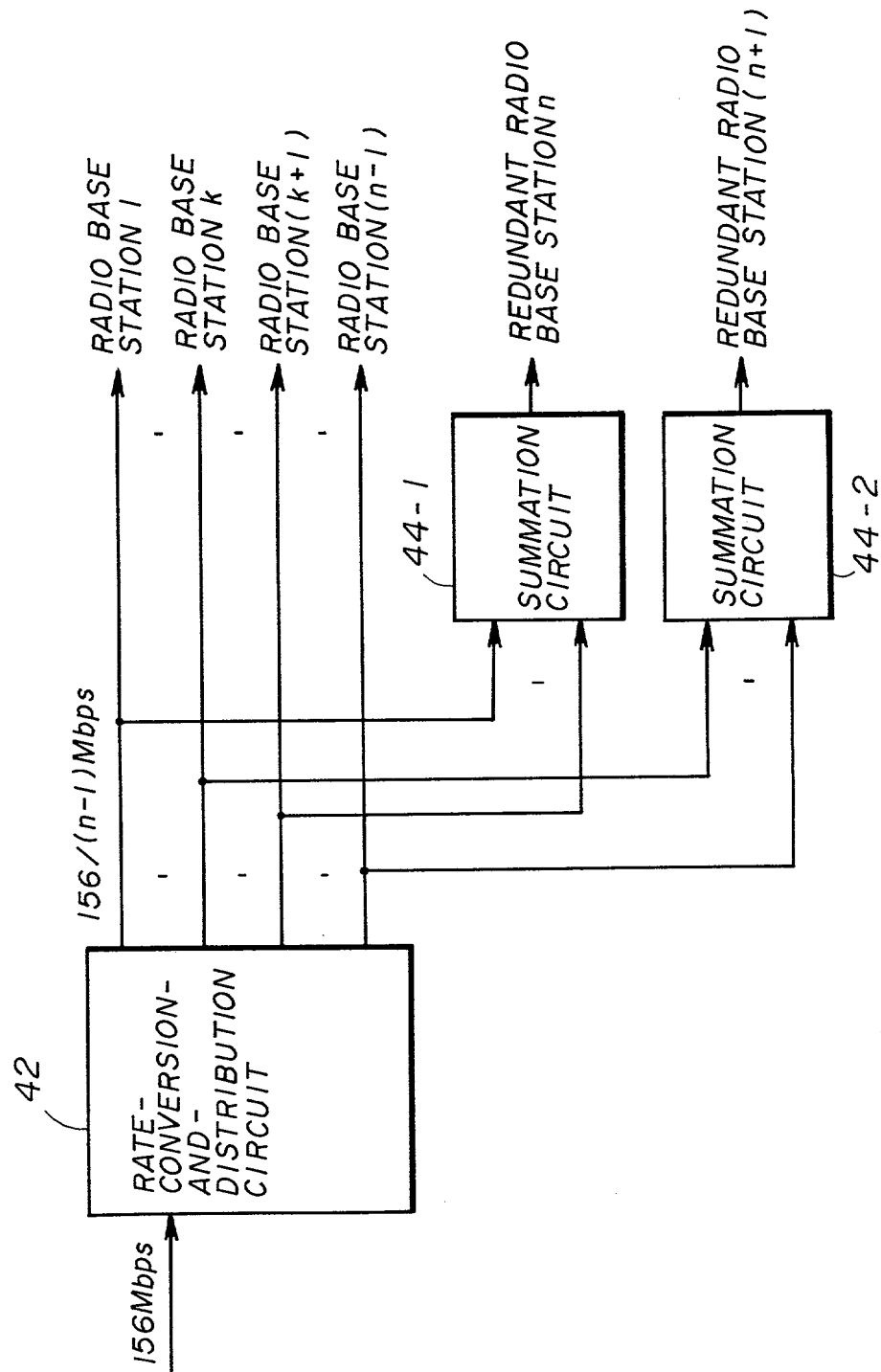


FIG. 9

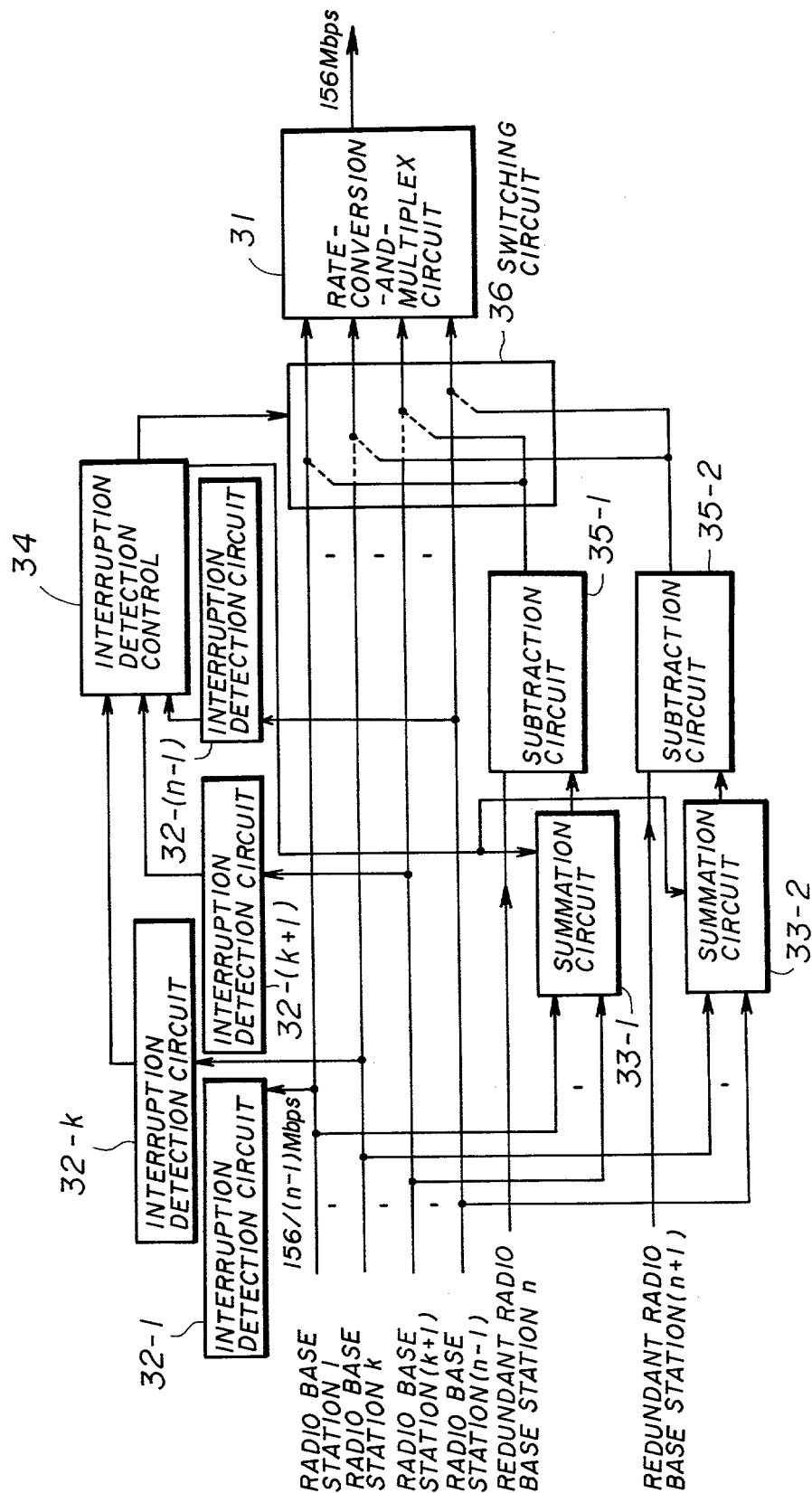


FIG. 10

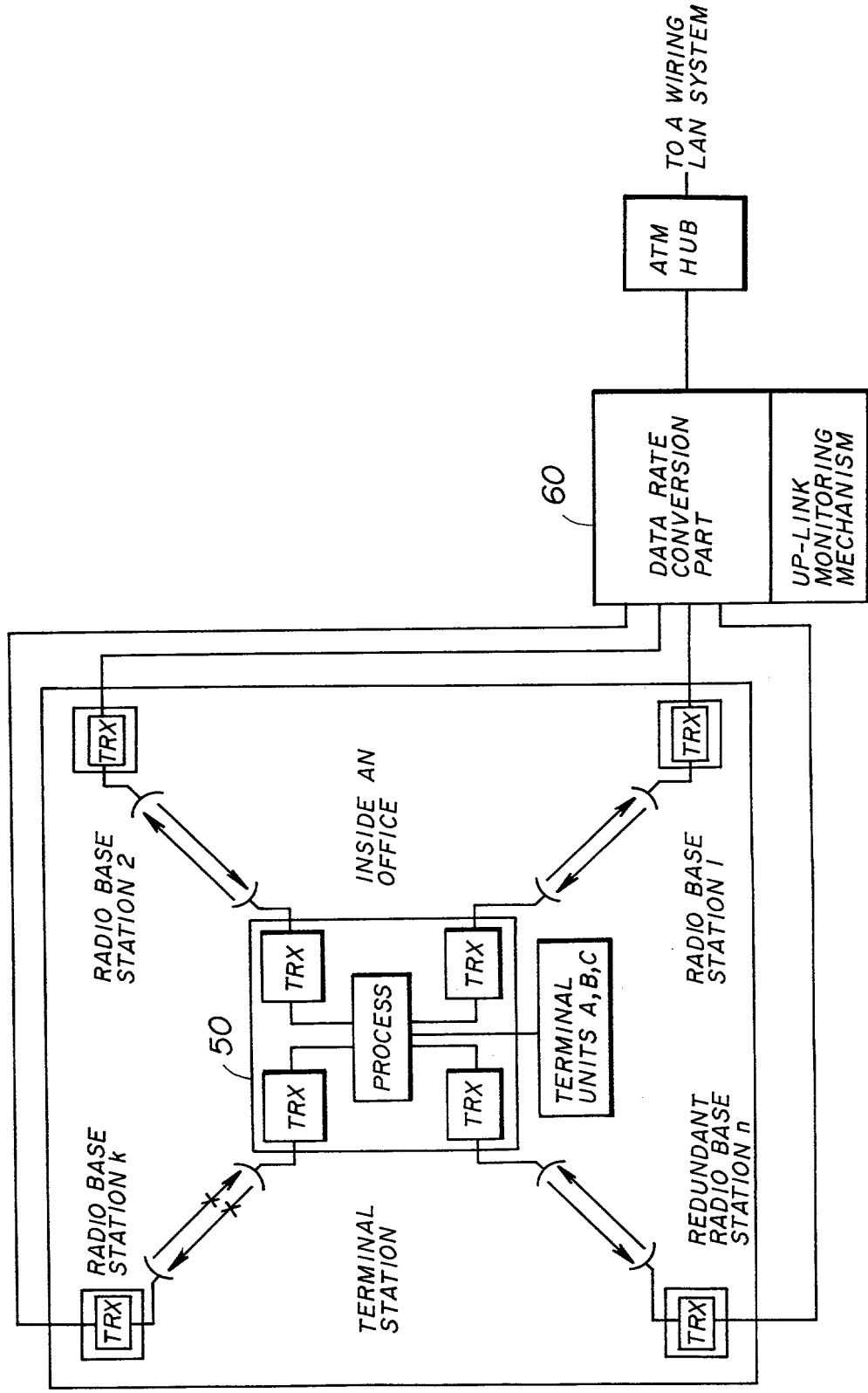


FIG. 11

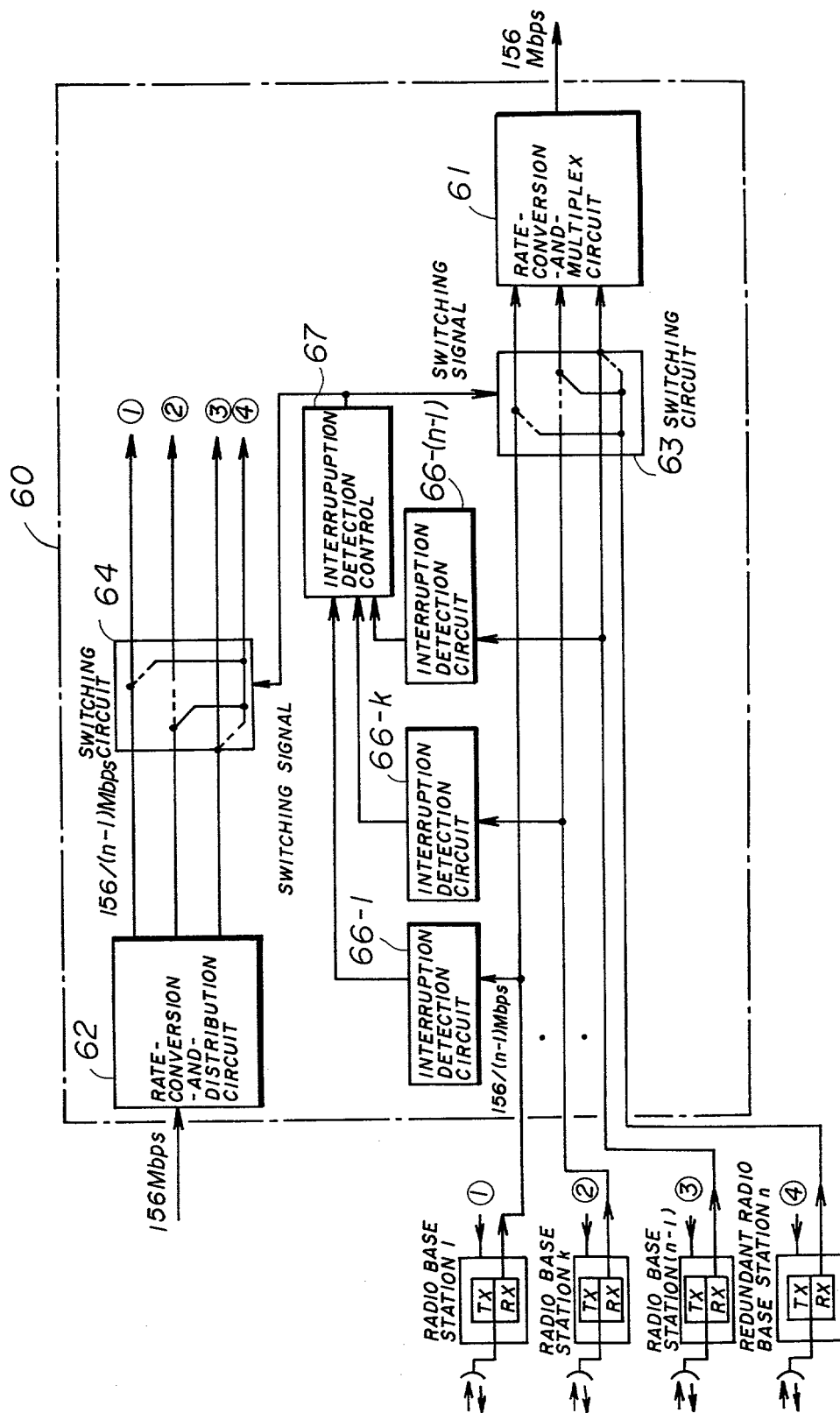




FIG. 12

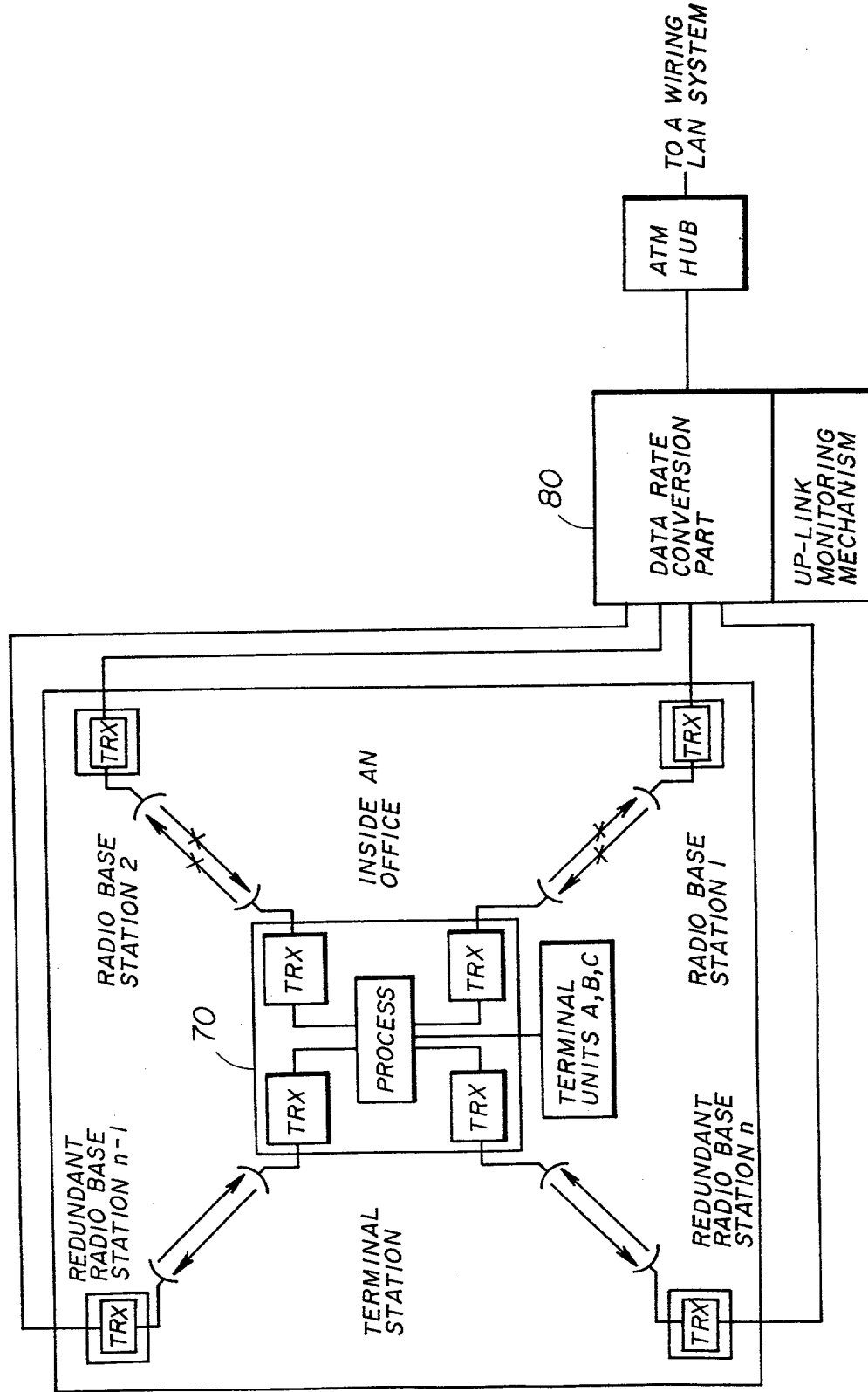
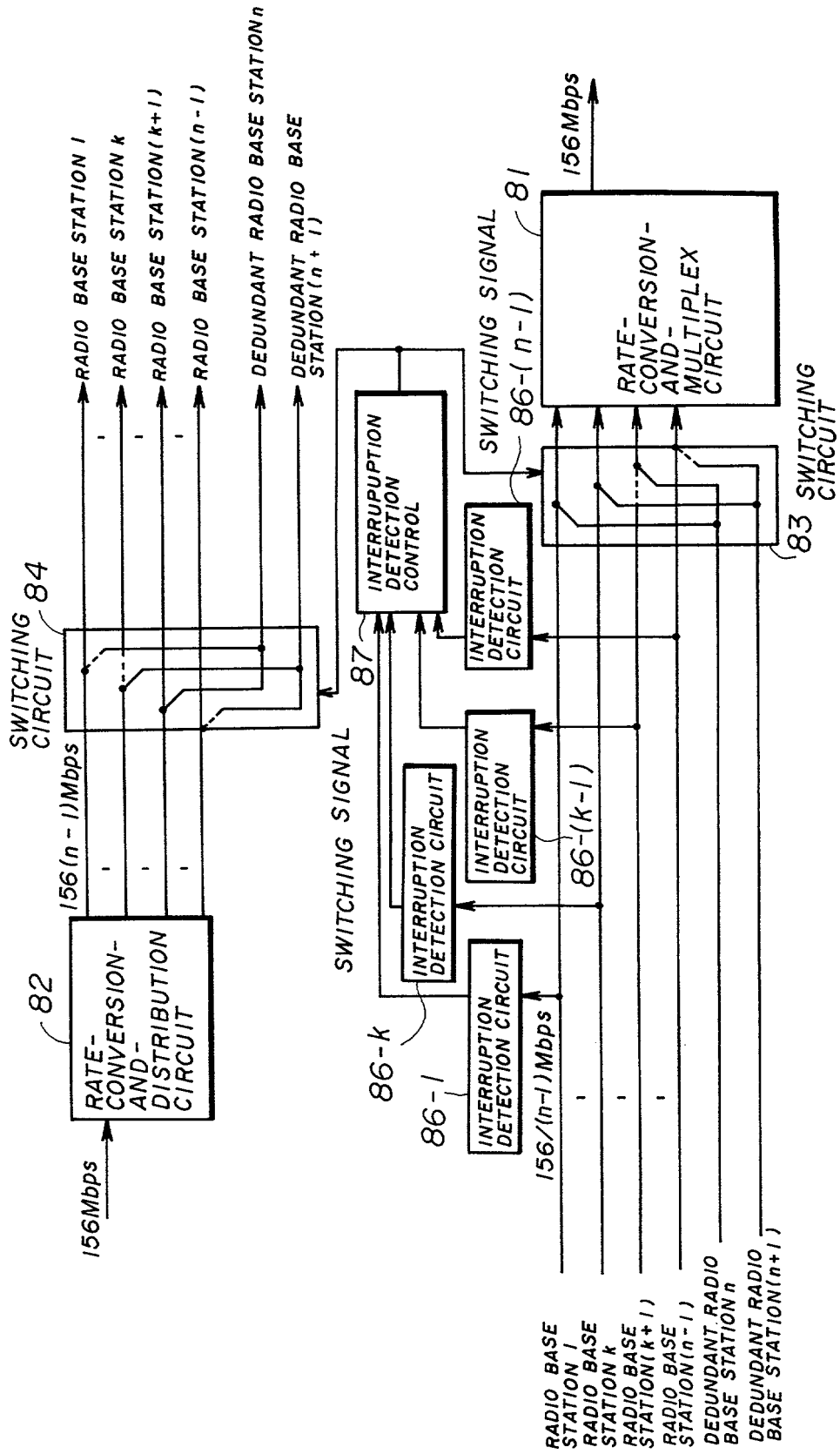


FIG. 13



## COMBINED DECLARATION/POWER OF ATTORNEY FOR UTILITY/DESIGN PATENT APPLICATION

As a below named inventor, I hereby declare that:  
My residence, post office address and citizenship are as stated below next to my name. I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled COMMUNICATION METHOD AND APPARATUS FOR A RADIO LOCAL AREA NETWORK SYSTEM USING

MACRODIVERSITY

the specification of which (check one) ☒ is attached hereto ☐ was filed on \_\_\_\_\_  
as U.S. Application Serial No. \_\_\_\_\_ and was amended on \_\_\_\_\_

(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in §1.56. I hereby claim foreign priority benefit(s) under 35 U.S.C. §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application(s) for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

## Prior Foreign Application(s)

Pat. Appln.

No. 8-189423

(Number)

Japan

(Country)

18/July/1996

Day/Month/Year Filed

## Priority Claimed

☒ Yes ☐ No

(Number)

(Country)

Day/Month/Year Filed

☐ Yes ☐ No

I hereby claim the benefit under 35 U.S.C. §120 of any U.S. application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application(s) in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)

(Filing Date)

(Status: patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

(Status: patented, pending, abandoned)

## POWER OF ATTORNEY:

As a named inventor, I hereby appoint the following attorneys and agent: James D. Halsey, Jr., 22,729; Harry John Staas, 22,010; David M. Pitcher, 25,908; John C. Garvey, 28,607; J. Randall Beckers, 30,358; James H. Marsh, Jr., 24,533; William F. Herbert, 31,024; Richard A. Gollhofer, 31,106; Mark J. Henry, 36,162; Paul F. Daebeler, 35,852; Gene M. Garner II, 34,172; Ilene D. Altman, 36,371; Michael D. Stein, 37,240; Paul I. Kravetz, 35,230; Gerald P. Joyce, III, 37,648; Todd E. Marlette, 35,269; Michael Lau, 39,479; Beverly A. Pawlikowski, 36,404; John P. Kong, 40,054 and William M. Schertler, 35,348 (agent) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. Send correspondence to: STAAS & HALSEY, 700 Eleventh Street, N.W., Suite 500, Washington, D.C., 20001, and direct telephone calls to: (202) 434-1500

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. §1001, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor Koji AraiInventor's Signature Koji Arai Date January 23, 1997Residence Kawasaki-shi, Kanagawa, JapanCitizenship JapanPost Office Address c/o FUJITSU LIMITED, 1-1, Kamikodanaka 4-chome, Nakahara-ku, Kawasaki-shi,  
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Full name of second joint inventor, if any \_\_\_\_\_

Second Inventor's Signature \_\_\_\_\_ Date \_\_\_\_\_

Residence \_\_\_\_\_

Citizenship \_\_\_\_\_

Post Office Address \_\_\_\_\_